TITLE OF THE INVENTION

NETTING MATERIAL WITH REFLECTIVE OR LUMINESCENT MARKER

FIELD OF THE INVENTION

The present invention relates to the field of packaging, and more particularly, to netting for baling agricultural produce.

BACKGROUND OF THE INVENTION

The use of balers for baling agricultural crops into round (cylindrical) bales has become increasingly common in recent years, replacing the old system of baling square bales which were secured by different types of twine or metal wire. The first round-balers also used various types of twines to secure the bale, however, over the years other types of netting have been used. The use of knitted Raschel nets has become more and more common. Raschel netting is a knitted netting and is made from polymeric material. Raschel netting includes a plurality of equally spaced longitudinal ribbons known as "franzes" and a plurality of intervening zigzag ribbons known as "schusses."

Information regarding Raschel netting, including details on its production, materials, and other aspects, can be found in U.S. Patent No. 4,569,439, U.S. Patent No. 5,104,714 and U.S. Patent No. 6,521,551. U.S. Patent No. 4,569,439 to Freye et al. describes netting for wrapping a round bale of agricultural blade crops. The Freye netting eliminates prior measures for fastening of the wrapping which were previously necessary. U.S. Patent No. 5,104,714 to Lieber et al. describes an elastic netting and a method for making the same, wherein linear low density polyethylene ribbons are knitted into a Raschel net. U.S. Patent No. 6,521,551 to Mass et al. describes a knitted netting that includes longitudinal polyolefin ribbons and lateral polyolefin ribbons knitted with the longitudinal polyolefin ribbons to form knitted netting. The lateral polyolefin ribbons of the knitted netting have an actual schuss length more than 110% of a calculated schuss length for the knitted netting, which prevents transverse shrinkage of the netting.

Nets for use in round baling machines are normally supplied in rolls of various diameters, typically up to 30 cm. The net is used to wrap crops with the required number of wraps around the circumference of the bale, typically two to four times. The number of bales that can be wrapped by one roll of net varies, and is determined by the length of net on the roll, the diameter of the wrapped bales, and the type of crop.

Typically, about 12 linear meters of net are required to wrap one bale. Different balers and different conditions require different measurements of net, but generally, a standard roll of net will wrap 150-300 bales.

One limitation with balers and net wrap is that only a limited amount of netting can be loaded into the designated compartment on the baler. As a result, the operator must reload the baler with a new roll of netting every time a roll is exhausted. Ideally, an operator should receive a warning well in advance, to avoid a situation where the remaining net will not be sufficient to wrap the crop being baled. In such a situation, the bale may leave the baler unwrapped or wrapped insufficiently, such that the bale may break apart and the crop be wasted.

Some balers are equipped with an electronic metering device that measures the amount of net applied to the bale. The metering device includes an electronic sensor that is associated with a free turning roller, over which the net is passed enroute to the bale. The sensing device is calibrated to give an approximation of the amount of the net that passes over it, in order to calculate when to stop feeding the net into the baler, i.e., depending upon how much net is required per bale (number of net layers on the bale). Thus the device is used as an indicator of the amount of net applied, and it can also indicate the total amount of net that has been passed over the free-turning roller. However, since this free-turning roller is exposed to the weather, and is generally dirty and/or includes debris in its bearing that can impede its free-turning ability, the existing metering may not be very reliable. Thus, the bale operator is not automatically warned that the end of the roll is approaching. Instead, the bale operator can only estimate or speculate when the end of the roll is near. Therefore , a visual indicator is still necessary.

In addition, the electronic metering is not very accurate since the length of net on each roll and the length of net used to wrap a single bale often vary. This is because the amount of material on a roll can deviate slightly from the stated manufacturer's specifications, and because the diameter of the bale itself can vary from bale to bale, requiring more or less netting than anticipated. When relying on an electronic metering device, the operator still must visually verify the quantity of net remaining for wrapping.

In light of the above problems, the market has demanded that the operator be visually warned when the roll of net is nearly exhausted. Such a solution would allow the operator to replace the exhausted roll in time, and avoid the danger of wasting crop.

Some solutions have been developed, all based on the principle of a variation in the color of the net towards the end of roll.

However, the existing roll-end markers are useful only in daylight conditions. They cannot meet the requirements of baling during reduced lighting conditions, e.g., the evening or nighttime, as they are typically difficult to see in low light situations. Night baling is often done in areas with hot, dry weather, in order to ensure the presence of a minimum required percentage of humidity in the crop being baled. Also, in rainy areas, farmers may bale their crops around the clock in an attempt to bale all the available crop before expected showers that would render baling impossible.

An additional problem encountered when baling at night, is that as the farmer works through the field, the bales made earlier become invisible and difficult to locate in order to bring them in to cover.

Heretofore, a satisfactory solution to the above described problems has not been proposed. Accordingly, described below and in the appended claims is netting incorporating markers suitable for enhancing visibility of wrapped bales in low light situations, as well as for indicating an approaching roll end when used in balers or other wrapping devices.

SUMMARY OF THE INVENTION

The present invention deals with the use of a reflective or luminescent strip with netting that makes the netting visible in low light or reduced light situations, and in certain embodiments extends the entire length of the netting, or marks the roll end, or both, in a manner visible in low light situations. The strip reflects a source of light even from a distance and even at a sharp angle, or alternatively emits light itself, depending on the specific embodiment. The reflective or luminescent strip may be incorporated into the net in addition to and optionally alongside colored roll-end markers that are easily visible in daylight.

An object of the invention is to provide a netting material with improved visibility during low light or reduced light conditions.

Another object of the present inventions is to provide a netting in which longitudinal and/or substantially lateral netting ribbons have been replaced and/or supplemented with reflective or luminescent strip.

A still further object of the present invention is to provide a netting that includes two or more substantially longitudinal netting ribbons, arranged substantially parallel to a longitudinal axis of the netting material, the longitudinal netting ribbons traversing a length of the netting material, one or more substantially transverse netting ribbons arranged substantially transverse to the longitudinal axis of the netting material, and a reflective or luminescent strip indicator arranged longitudinally on the netting material continuously from one end of the netting material to the other end or to a point located at a predetermined distance from that one end, the reflective indicator acting as a visual signal to user that an end of the netting material is approaching.

A further object is to provide a netting in which at least one or more of the longitudinal ribbons or lateral ribbons has been replaced or supplemented with the reflective or luminescent strip marker.

A still further object of the invention is to provide methods for providing a reflective netting and methods for wrapping a bale including supplying a baler with a netting material with reflective markings to provide low light or reduced light visibility, and wrapping the bale in the same netting using a baling machine.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates an isometric view of a first embodiment of the present invention;

Figure 2 illustrates in detail, one option for forming loops in the longitudinal franzes of Raschel netting;

Figure 3 illustrates a top view of a first embodiment of the present invention;

Figures 4 and 5 illustrate a second embodiment of the present invention, including a partially unrolled Raschel netting material with an added reflective strip alongside a longitudinal franze;

Figure 6 illustrates a third embodiment of the present invention including reflective strips incorporated into the netting material alongside both the longitudinal franzes and zigzag schusses;

Figure 7 illustrates a fourth embodiment of the present invention in which a reflective strip has been incorporated into the netting material to replace a single schuss;

Figure 8 illustrates a wrapped bale, wrapped in a representation of a fifth embodiment of the netting material, depicted as if in low light conditions with a distant light being shone on the wrapped bale;

Figure 9 is a photograph of the netting according to the fifth embodiment of the present invention taken with a flash;

Figure 10 is a nighttime photograph of distant bales wrapped in the claimed netting material, where a reflective strip is used in a zigzag fashion; and

Figure 11 is a photograph of the netting according to the fifth embodiment of the present invention taken without use of a flash.

DETAILED DESCRIPTION OF THE DRAWINGS

The present invention utilizes at least one reflective or luminescent strip which is incorporated into a netting material. Although the hereinafter described non-limiting embodiments focus on Raschel knitted netting, the inventive reflective or luminescent marker strips can also be used with other netting materials that are used to bale crops. U.S. Patent Nos. 5,104,714 and 6,521,551, which are each directed to Raschel knitted netting, are incorporated herein by reference.

In some embodiments described herein, the reflective or luminescent strip is added to the net alongside a least one of the longitudinal ribbons or at least one of the substantially transverse or lateral ribbons or both. In the case of Raschel netting, the longitudinal and substantially lateral ribbons are respectively referred to as franzes and schusses.

In other embodiments described hereinafter, at least one strip is incorporated into the netting to replace the longitudinal and/or transverse ribbons. Alternatively, some ribbons can be replaced with the strips, while the reflective/ luminescent strips are added alongside others. The reflective strips can extend the entire length of the netting or can extend for a predetermined part of the netting on a roll. Additionally, the reflective or luminescent strips may themselves have a predetermined color that is visible during the day and/or the night.

With Raschel netting, embodiments in which the lateral ribbon is replaced are preferable to the others for at least two reasons. First, replacing a longitudinal strip with a reflective strip may weaken the net's overall strength, whereas the lateral ribbons have a minimal effect on the overall strength of the net. Secondly, a reflective lateral

strip is more visible from a distance than the longitudinal ribbons because it creates a reflecting area that is as wide as the space between two adjacent longitudinal franzes, as lateral ribbons zigzag across that space.

Because the strip tends to twist while being knitted into the roll of net and while the net is being used, a preferred type of strip is reflective or luminescent on both faces.

Depending on the specific embodiment, the reflective/luminescent strip can be incorporated into the net for a predetermined length, providing a warning for the last 100 linear meters of net, an amount sufficient for wrapping about 8 bales, or any other length that could be desired.

Since a bale itself cannot usually be seen at night unless the operator drives by it, at least one reflective/luminescent marker may be inserted along the entire length of the net in order to increase low- or reduced- light visibility of every bale that may be on a field. For example, reflective/luminescent markers can be located adjacent to the lateral side(s) of the netting, adjacent to the center, or any location.

In a test performed by applicants, it was found that when a tractor's lights fall on a bale having a reflective strip, the bale can be seen even from a distance of 50 meters, and in some conditions even from a distance of 100 meters. In such conditions, the operator may notice the bale even if it is across a field.

Alternatively, netting can be provided with at least one reflective/luminescent marker along the entire length of the net, with a second reflective/luminescent marker only at the end of the net serving as a roll-end marker.

The invention will now be described with reference to the drawing figures. Figures 1 and 3 illustrate a first embodiment of the present invention in isometric and top views, respectively. Figures 1 and 3 show a partially unrolled Raschel netting material 100, in which a reflective strip 110 has been added to the netting 100. In this embodiment, the reflective strip 110 is inserted into the net adjacent to one of the zigzag schusses 120. The longitudinal franzes 130 are shown. The reflective strip 110 can be threaded into the netting material such that at its apexes 115, it only passes through the apertures 140, 145 defined by the schusses and franzes, merely passing around the franze 130 at that point. Alternatively, the reflective strip 110 may be threaded or knitted into the netting material 100 in such a manner that it passes through apertures 230, 250 (described below in connection with Figure 2) which are an integral part of the

longitudinal franzes 130. Although Figures 1 and 3 illustrate the use of a single reflective strip 110, more than one reflective strip, at any desired position across the netting can be used.

Figure 2 illustrates in more detail, how the loops 230, 250 in the longitudinal franzes 130 of Raschel netting 100 are formed. A single strand of material 210 is used to form the entire franze. Since only a segment is shown in Figure 2, each end of the segment is shown as terminating in a single strand 210 and in a loop 220 from an adjacent segment, but these loops 220 occur at regular intervals throughout the length of the franze 130, and create links 240. These links 240 separate adjacent apertures 230, and provide a secure location through which to loop schusses 120, preventing the schusses from sliding along the franzes 130. In this embodiment, the schuss 120 passes through the apertures 230. In a similar manner, the reflective strip 110 may be secured to the franzes 130. As can be seen, it would also be possible to utilize apertures 250 to secure the schuss 120 or reflective strip 110.

Still referring to Figures 1-3, since the purpose of using the reflective strip 110 is precisely for that reason, that is, for reflecting light, the strength of the reflective strip is not important if it is included in the netting material 100 in an accessory capacity. Further, if included alongside schusses 120, the strength is even less important, since most internal stresses in the netting material are experienced as tension in the longitudinal franzes 130. Naturally, in either instance, if the reflective strip 110 is used as a substitute for the regular material of either the schusses 120 or franzes 130 (as described in more detail below), then the strength of the material should be appropriate for the intended purpose. However, some cost savings are realized over a situation where the reflective material 110 is "doubled up" with a franze 120 and/or a schuss 130.

Figures 4 and 5 illustrate a second embodiment of the present invention. As shown, a partially unrolled Raschel netting material 400, includes an added reflective strip 112 alongside a longitudinal franze 130. The reflective strip 112 in this embodiment may be threaded along and around the franze 130 through apertures 140 and 145, or may be threaded through or knitted into the apertures 230 or 250 during the manufacture of the net. As with the embodiments of Figures 1-3, more than one franze ribbon may be replaced and/or supplemented with a reflective strip.

In both first and second embodiments illustrated in Figures 1 - 3 and 4 - 5, as well as in the below-described embodiments, the reflective strip 110 or 112 tends to

twist as it runs the length of the netting material 100, 400. As such, it is often preferable to incorporate a reflective material that has reflective surfaces on both sides (if the reflective strip is in the form of a flat ribbon), or all sides (if the reflective strip is in the form of a string, rope or the like).

Figure 6 illustrates a third embodiment of the present invention in which reflective strips 110 and 112 have been incorporated into the netting material 600 alongside both the longitudinal franzes 130 and zigzag schusses 120. The manners in which the reflective strips 110 and 112 may be secured to the netting material 600 are the same as described in the first and second embodiments, respectively.

However, it is not necessary for both the schuss reflective strip 110 and the franze reflective strip 112 to be inserted into the netting material in the same manner. For example, one reflective strip 110 or 112 can be inserted by threading into already manufactured net 600, and the other reflective strip 112 can be inserted by knitting directly into the netting material 600.

Figure 7 illustrates a fourth embodiment of the present invention in which a reflective strip 110 has been incorporated into the netting material 700 to replace a single schuss 120. When used as a replacement for a schuss 120, that is, as reflective schuss 710, the reflective material 110 will be knitted into the netting material 700 during manufacture. While a single schuss ribbon has been replaced with a reflective schuss ribbon, it is also possible to replace more than one, or even all the schuss ribbons with reflective schuss ribbons. It is also possible to replace the franze ribbons in a similar manner. The entire length of the franze or schuss ribbons can also be reflective.

Figure 8 illustrates a wrapped bale 800, wrapped in a representation of a fifth embodiment of the netting material 860, depicted as if in low light conditions with a distant light being shone on the wrapped bale 800. This embodiment of the netting material 860 includes the reflective schuss 710 of the fourth embodiment in combination with colored, non-reflective franzes 830 arranged together in an indicator section 850. Such non-reflective colored franzes 830 facilitate viewing of the indicator in bright light, and may be any color, but are often red. Where standard contrasting materials are easily noticed in daylight, and difficult to see at night, the reflective strip 110 is easily noticed at night when light is reflected from the strip 110, even from a large distance. However, standard reflective materials usually appear to be silver or gray in daylight and brilliantly white or silver at night, when illuminated. Accordingly, it is sometimes difficult to see

reflective materials in the daytime, and for that reason, contrasting color materials, such as colored franzes 830 are used.

As an alternative to this approach, a reflective material having a color can be utilized. For example, rather than appearing silver or gray in daylight, a colored reflective material can be manufactured to appear red during the day and still be reflective at night.

Figure 9 is a photograph of the netting 860 according to the fifth embodiment of the present invention taken with a flash. In this embodiment, rather than simply utilizing the reflective schuss 710, the reflective strip 110 is included adjacent to the standard schuss 120, as in the first embodiment shown in Figures 1 and 3. In this version of the netting material 860, four colored franzes 830 and one reflective strip 110 are provided. As shown in Figures 8 and 9, these indicator sections 850, 950 are centrally located relative to the width of the net 860, however this placement is not required, and the indicator sections 850, 860 may be placed anywhere: near one edge or along both edges, for example.

Figure 10 is a nighttime photograph of distant bales wrapped in the claimed netting material, where a reflective strip 110 is used in a zigzag fashion, as shown in Figures 1, 3, 7, 8 and 9. As seen in this photograph, which was taken using a camera flash, the nearest bales 1010, 1020, 1030 and 1040 are easily located due to the bright reflections experienced from the reflective strip 110. However, one can also see bales further from the photographer 1050 and 1060, which although twice as far from the photographer, still reflect enough light that they are visible, although the reflections are somewhat more dim.

Figure 11 is a photograph of the netting 860 according to the fifth embodiment of the present invention taken without use of a flash. As with the netting 860 in Figure 9, in this embodiment, rather than simply utilizing the reflective schuss 710, the reflective strip 110 is included adjacent to the standard schuss 120, also as in the first embodiment shown in Figures 1 and 3. In this version of the netting material 860, four colored franzes 830 and one reflective strip 110 are provided. In comparison with Figure 9, a photograph of the same piece of netting but with use of a flash, the need for a secondary indicator (such as colored franzes 830) in daylight is easily seen. The photograph of Figure 11 (without a flash), does not show great contrast between the reflective strip 110 and the rest of the netting material 860. With a flash (Figure 9),

however, the distinction is clear. Accordingly, it may be desirable in some instances to use both reflective strips 110 and colored ribbons in colored franzes or schusses.

In all embodiments, the schusses 120 and franzes 130, whether reflective or non-reflective, and strips 110, 112 can be manufactured out of many materials, including, but not limited to polymeric materials, such as polypropylene, polyethylene, polyester, polyethylene terephthalate, nylon, polyvinyl chloride. Also, the thread, ribbon or strips comprising the schusses 120, franzes 130, and reflective strips 110, 112 can be monofilament or multifilament, woven, twisted or braided, and may alternatively be called string, tape, yarn or the like.

In many embodiments, reflective and/or colored elements are provided as an indicator for approximately the last 100 linear meters of net, which is enough material for approximately 8 bales. As an alternative, the roll-end indicator may have additional features, such as color or pattern-changing as the roll end approaches. For example, the first roll end indicator seen (e.g., 100-80 meters from the end of the net) can have a yellow tinge, which can change as netting continues to be dispensed to orange and/or red as the net end approaches. In such instance, the operator would be aware that the net end is approaching when he sees yellow, but would know that by the time red is seen, there is only enough netting material for at most one more bale. As such, material need not be wasted by discarding un-used net. This general concept of the roll-end indicator can be applied to non-reflective indicators as well, where the color changes as the roll end approaches. Further, this variation can also be used in combination with a continuous reflective marker throughout the length of the net.

When wound on a spool or core, the roll end is the portion of net closest to the core. Accordingly, during manufacture, this section can be prepared first and wound onto the core, with the remainder of the netting material being manufactured in a conventional manner and wound on the core over the reflective portions.

When a reflective material is used as the mark, the reflective material has a coefficient of retroreflection (R_A), in the range of 30 to 700, for example, 250. The tensile strength of the marker, as discussed above, depends on whether it replaces a franze or schuss, or whether it is used in addition to the franze or schuss ribbon as discussed herein. Marker tensile strengths on the order of 140-800 grams are contemplated. Similarly, elongation capability of the marker depends on whether the marker is a replacement for a franze or schuss or supplements the franze or shuss, as discussed

herein. Materials used as a marker can have elongation between 0% and 200%, for example, 10%, 20%, 30%,40%, 50%, 60% etc.. In addition, the marker material can have the same or different elongation properties that those of the franze or schuss ribbon that it replaces or supplements.. A reflective material can include polymeric material that is made reflective by the addition of refractive particles, such as very small beads formed from glass or polymeric materials.

Further, the reflective material may have any suitable width such as between 1/69 inch and 10 inches, for example 1/69 inch, 1/32 inch or 1/23 inch.

As discussed herein netting material, whether of the triangular pattern type, e.g., Raschel netting, or any other pattern, quadrilateral or otherwise can incorporate the reflective indicator throughout the entire length of the netting material so that any bale wrapped with the material is visible at night.

In other embodiments the subject netting material incorporates a first reflective indicator throughout the entire length of the netting material, and a second reflective indicator at the end of the netting material. In this case, the first reflective indicator allows any bale wrapped with the material to be visible at night, while the second indicator allows an operator to be alerted to an approaching end of the netting material. In such a case, the first and second reflective indicators would necessarily be distinguishable. Such distinction can be achieved by providing a separate or different pattern and/or color for each indicator, or even simply placing the reflective indicators at different positions on the net. For example, a first indicator can be arranged in the middle of the net, with the second indicator being arranged toward one edge of the net, or vice versa. Of course, this alternative embodiment may also include colored netting elements to alert an operator to an approaching roll end in daylight.

A further alternate means of distinguishing between a continuous (throughout the entire net length) indicator and a roll end indicator incorporates a single strand of indicator material. Such indicator itself can vary in color or pattern throughout its length to indicate whether the end of netting material is approaching. For example, the indicator material may be solid for a majority of its length, but in the region where roll-end indication is desired, the reflectivity of the reflective strand can be varied. That is, what is otherwise a "solid" reflective strand can become an intermittently reflective strand. This can be achieved simply by obscuring intermittent portions of the reflective strand with opaque paint or the like.

While netting may be initially manufactured to incorporate a reflective indicator, such indicator may be incorporated into a roll that has already been manufactured. If an existing roll of netting is to be modified, it is possible to incorporate a reflective marker into the net, and wind the net onto another spool or core.

While the above embodiments include a reflective and/or colored roll-end indicator that is integrated into the netting material in a substantially longitudinal direction, it is possible to include markers that are arranged in a substantially transverse manner. For example, rather than incorporating a zigzag reflective schuss, segments of reflective strips along the width of the netting can be inserted intermittently along the length of the netting, perpendicular to a longitudinal axis of the netting material. This alternative means of reflective indication can communicate information to an operator in a variety of manners. For example, different color reflective materials can be used as the roll end approaches and/or the frequency of transverse reflective indicators can be increased, placed adjacent to each other in pairs, threes, and so on.

A further variation of the subject reflective and/or colored indicators provides different colored and/or patterned indicators for different crops. As a result, if stored in a dark barn or in a field, a baled crop can be quickly and easily identified.

It is to be understood that the term "reflective" has been used above to describe the type of marker preferred for the present invention, that a luminescent marker may be substituted in its place. Such luminescent markers may include so-called "glow in the dark" materials. Further materials having a fluorescent color that is easily viewable in poor lighting conditions may also be used.

It is to be understood that other embodiments utilizing the subject reflective markers are possible and though not specifically set forth herein would still be in keeping with the spirit of the invention.